What is Claimed Is:

1. A method of manufacturing a magnetic recording medium, comprising sequential steps of:

(a) providing an apparatus for manufacturing said medium;

(b) supplying said apparatus with a substrate for said medium;

(c) forming a magnetic recording layer on said substrate in a first portion of said apparatus;

(d) treating said magnetic recording layer with oxygen gas in a second portion of said apparatus at a sub-atmospheric pressure and for an interval sufficient to provide the resultant medium with at least one of the following, relative to a similar medium manufactured by a similar method but wherein the oxygen treatment of step (d) is not performed:

(i) a more negative nucleation field (H_n);

(ii) increased remanent squareness (S_r);

(iii) increased signal-to-medium noise ratio (SMNR);

(iv) narrower switching field distribution (SFD); and

(v) decreased thermal decay rate; and

(e) forming a protective overcoat layer on said oxygen-treated magnetic recording layer in a third portion of said apparatus.

2. The method according to claim 1, wherein:

step (a) comprises providing an apparatus including at least said first, second, and third spaced-apart portions.

3. The method according to claim 2, wherein:

step (a) comprises providing an apparatus adapted for continuous manufacture of a plurality of media and including means for transporting said substrate serially through said first, second, and third spaced-apart portions.

4. The method according to claim 3, wherein said first, second, and third spaced-apart, serially arranged portions of said apparatus respectively comprise first, second, and third spaced-apart chambers and at least said second chamber is adapted for providing a sub-atmospheric pressure therein.

5. The method according to claim 4, wherein said second chamber comprises means for flowing a mixture of oxygen gas diluted with an inert carrier gas past a surface of said magnetic recording layer formed on said substrate in step (c).

6. The method according to claim 4, wherein said first and third chambers of said apparatus are adapted for performing a thin film deposition process therein.

7. The method according to claim 6, wherein at least said first chamber of said apparatus is adapted for performing a sputtering process therein.

8. The method according to claim 1, wherein:

step (c) comprises forming a magnetic recording layer selected from the group consisting of: (1) a Co-based alloy, Cr-rich grain boundary type magnetic layer; (2) a granular type magnetic layer; (3) a superlattice-type layer; and (4) an $L1_0$ ferromagnetic metal alloy type layer.

9. The method according to claim 8, wherein:

step (c) comprises forming a Co-based alloy, Cr-rich grain boundary type magnetic recording layer comprised of a CoCrPtX alloy, where X = at least one element selected from the group consisting of Ta, B, Mo, V, Nb, W, Zr, Re, Ru, Cu, Ag, Hf, Ir, and Y, and wherein Co-containing grains with *hcp* lattice structure are segregated by Cr-rich grain boundaries.

10. The method according to claim 9, wherein:

step (d) comprises treating said magnetic recording layer with a gas mixture comprising up to about 20 % oxygen gas in at least one inert diluent gas, at a total gas pressure up to about 50 mTorr, and for an interval up to about 10 sec.

11. The method according to claim 10, wherein:

step (c) further comprises utilizing a heated substrate during formation of said magnetic recording layer to effect segregation of Cr in said grain boundaries.

12. A perpendicular magnetic recording medium manufactured by the method according to claim 11.

13. The method according to claim 8, wherein:

step (c) comprises forming a granular-type magnetic recording layer comprised of a CoPtX alloy, where X = at least one material selected from the group consisting of Cr, Ta, B, Mo, V, Nb, W, Zr, Re, Ru, Cu, Ag, Hf, Ir, Y, SiO_2, SiO, Si_3N_4, Al_2O_3, AlN, TiO, TiO_2, TiO_x, TiN, TiC, Ta_2O_3, NiO, and CoO, and wherein Co-containing grains with *hcp* lattice structure are segregated by oxide, nitride, or carbide grain boundaries.

14. The method according to claim 13, wherein:

step (d) comprises treating said magnetic recording layer with a gas mixture comprising up to about 20 % oxygen gas in at least one inert diluent gas, at a total gas pressure up to about 50 mTorr, and for an interval up to about 10 sec.

15. The method according to claim 14, wherein:

step (d) comprises treating said magnetic recording layer with oxygen gas without applying heat thereto.

16. A perpendicular magnetic recording medium manufactured by the method according to claim 15.

17. The method according to claim 8, wherein:

step (c) comprises forming a superlattice-type magnetic recording layer comprising a multi-layer $(CoX/Pd)_n$ or $(CoX/Pt)_n$ structure, where n is an integer from about 10 to about 25 and X is an element selected from the group consisting of Cr, Ta, B, Mo, Pt, W, and Fe; and

step (d) comprises treating said magnetic recording layer with oxygen gas without applying heat thereto.

18. A perpendicular magnetic recording medium manufactured by the method according to claim 17.

19. The method according to claim 8, wherein:

step (c) comprises forming an $L1_0$ ferromagnetic metal alloy-type layer comprising a FePt or CoPt alloy.

20. A perpendicular magnetic recording medium manufactured by the method according to claim 19.

21. The method according to claim 1, wherein:

step (b) comprises supplying said apparatus with a disk-shaped substrate for a hard disk magnetic recording medium.

22. A disk drive comprising a magnetic recording medium formed by the process according to claim 21.

23. The method according to claim 1, wherein:

step (e) comprises forming a carbon-based protective overcoat layer on said oxygen-treated magnetic recording layer.

24. A method of manufacturing magnetic recording media according to a continuous process, comprising sequential steps of:

(a) providing at least one substrate for said magnetic recording media;

(b) providing an apparatus adapted for continuous manufacturing of said magnetic recording media, comprising at least first, second, and third spaced-apart, serially arranged processing chambers and including means for transporting said at least one substrate serially through at least said first, second, and third spaced-apart processing chambers;

(c) transporting said substrate through said first processing chamber while forming a magnetic recording layer thereon;

(d) transporting said substrate with said magnetic recording layer formed thereon to said second processing chamber;

(e) transporting said substrate through said second processing chamber while treating said magnetic recording layer with oxygen gas at a sub-atmospheric pressure and for an interval sufficient to provide the resultant media with at least one of the following, relative to similar media manufactured by a similar method but wherein the oxygen treatment of step (e) is not performed:

(i) a more negative nucleation field (H_n);

(ii) increased remanent squareness (S_r);

(iii) increased signal-to-medium noise ratio (SMNR);

(iv) narrower switching field distribution (SFD); and

(v) decreased thermal decay rate;

(f) transporting said substrate with said oxygen-treated magnetic recording layer formed thereon to said third processing chamber; and

(g) transporting said substrate through said third processing chamber while forming a protective overcoat layer on said oxygen-treated magnetic recording layer; wherein:

said substrate is transported between and through each of said first, second, and third processing chambers at a substantially constant rate.

25. The method according to claim 24, wherein:

step (a) comprises providing at least one disk-shaped substrate for hard disk magnetic recording media;

step (b) comprises providing an apparatus wherein said first and third chambers are adapted for performing a thin film deposition process therein and at least said second chamber is adapted for providing a sub-atmospheric pressure therein; and

step (c) comprises forming a magnetic recording layer selected from the group consisting of: (1) a Co-based alloy, Cr-rich grain boundary type magnetic layer; (2) a granular type magnetic layer; (3) a superlattice-type layer; and (4) an $L1_0$ ferromagnetic metal alloy type layer.